

## Remarks / Arguments

The first modifications from the original drawings were done in response to the office action of 1-17-01. The modification at that time entailed the resizing of the drawings that were referred to as illegible. The drawings submitted at that time were (still) not in the required format.

Additional modifications have been performed to comply with the office action of 8-13-01. The equations have been removed from the specification and included with the drawings. Each (drawing) entry is properly identified with a "FIG." Preceding the drawing number. All of the drawing entries were modified so that they are clear and legible, and displayed in portrait orientation. All text was removed from the drawings. The drawings are now displayed in the proper format.

In this marked-up original, any material that has been removed (for the clean version) is surrounded with brackets ({}). New/added material that was not in the original is underlined(\_). Comments are surrounded by asterisks (\*).

Version with markings to show changes made.

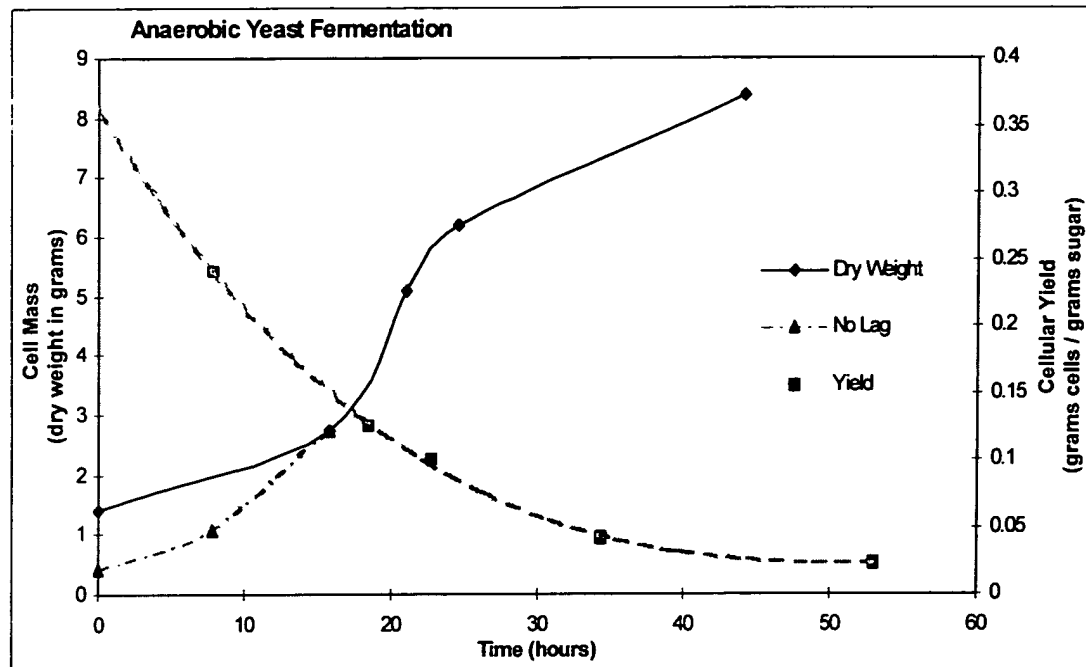
Original Drawings

Forward to: Official Draftsperson

## DRAWINGS

\*Graph modified\*

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**Figure 1**

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\*revised graph\*

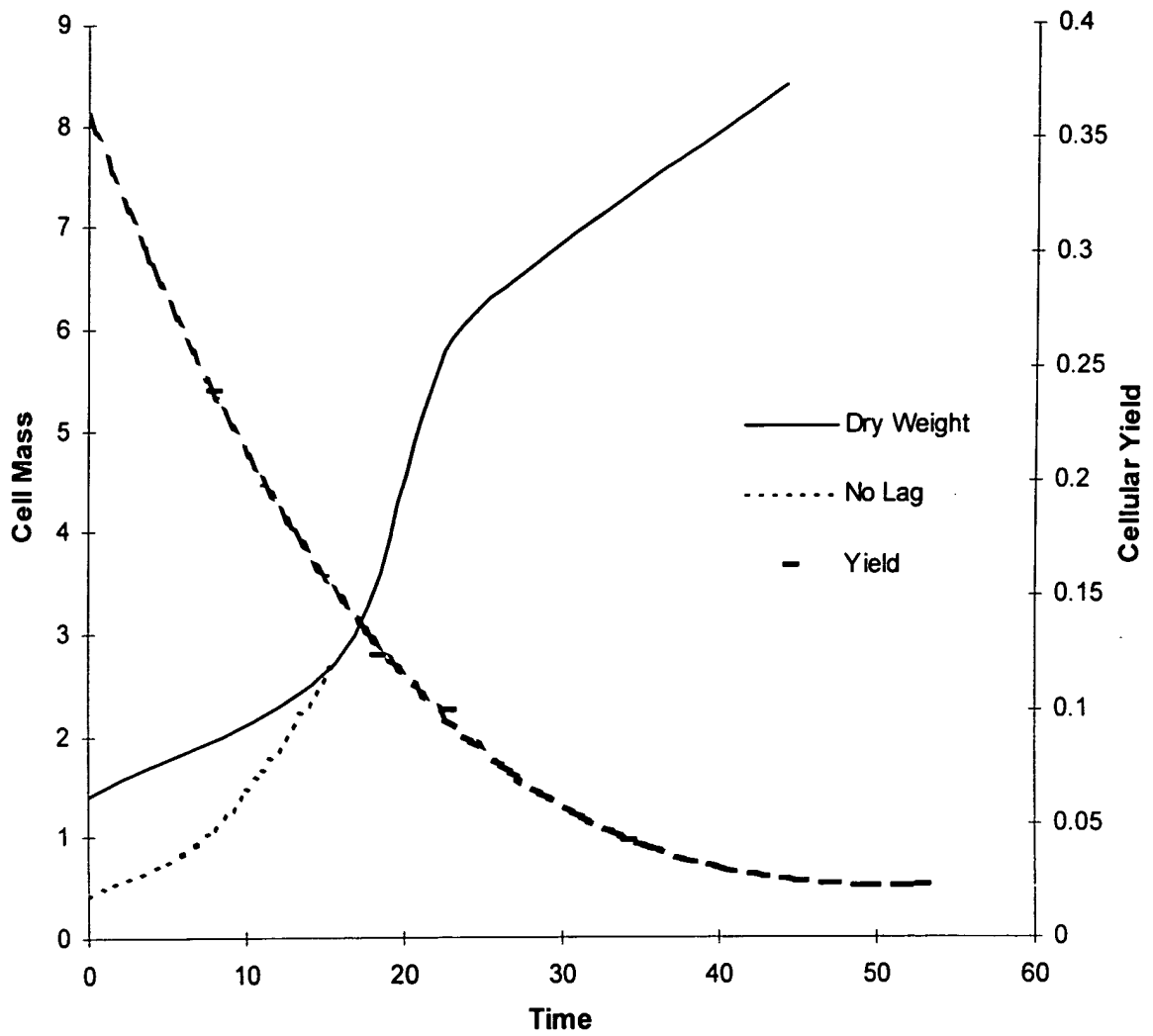
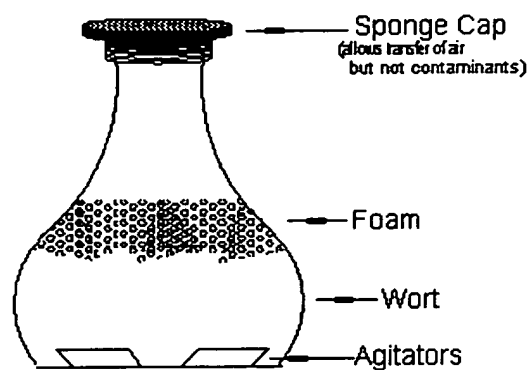


FIG.1

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\*Drawing modified\*

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2 liter Fernbach Flask

Oxygen transfer is limited by the small surface area on the top, and the foam that forms.

Figure 2

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\*Revised drawing\*

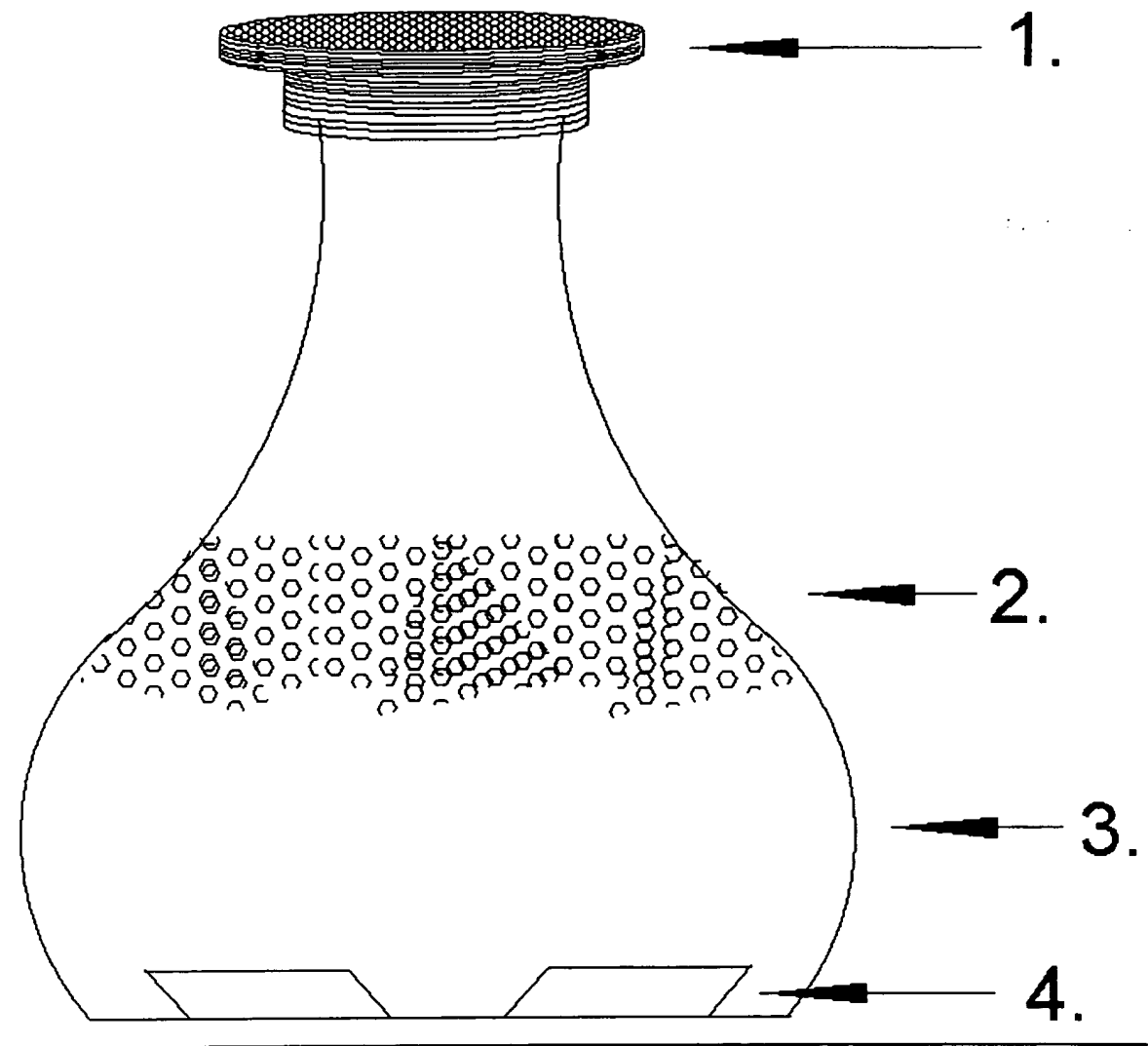


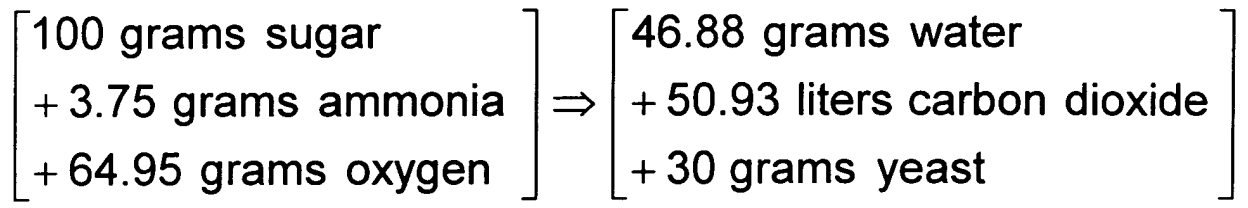
FIG.2

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\*Equation added\*

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**FIG.3**

\*Table modified\*  
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Time During Fermentation	Yield (g cells/ g sugar)	Ammonia Needed (grams)	Water Produced (grams)	CO <sub>2</sub> Produced (liters)	Yeast Produced (C <sub>6</sub> H <sub>10</sub> O <sub>3</sub> N) (grams dry wt.)	Ethanol Produced (C <sub>2</sub> H <sub>6</sub> O) (grams)*
1st 3rd	.15	18.70	5.1	22.51	15.04	41.19
2nd 3rd	.052	.65	1.79	25.54	5.20	47.68
3rd 3rd	.023	.29	.79	26.44	2.30	49.61
Overall	.05	.626	1.72	25.60	5.00	48.52

\* For ethanol volume, divide weight (in grams) by its' density (0.789 grams/ml)

**Table 1**

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\*Revised table\*

Time During Fermentation	Yield (g cells/ g sugar)	Ammonia Needed (grams)	Water Produced (grams)	CO <sub>2</sub> Produced (liters)	Yeast Produced (C <sub>6</sub> H <sub>10</sub> O <sub>3</sub> N) (grams dry wt.)	Ethanol Produced (C <sub>2</sub> H <sub>6</sub> O) (grams)*
1st 3rd	.15	18.70	5.1	22.51	15.04	41.19
2nd 3rd	.052	.65	1.79	25.54	5.20	47.68
3rd 3rd	.023	.29	.79	26.44	2.30	49.61
Overall	.05	.626	1.72	25.60	5.00	48.52

**FIG.4**

\*Equations added\*

$$\text{CO}_2 \text{ solubility (in l CO}_2\text{/l H}_2\text{O)} =$$
$$\frac{-1.06556266071 \times \ln(^{\circ}\text{F}) + 5.38424482284}{}$$

**FIG.5**



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$$\frac{\text{Change in yeast mass}}{\text{Change in time}} = \frac{\Delta X}{\Delta t} = \mu \times X$$

$$\ln \left[ \frac{X}{X^0} \right] = \mu \times (t - t_{\text{lag}})$$


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FIG.6

$$t_d = \frac{\ln(2)}{\mu}$$


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FIG.7

$$\text{Ratio} \left[ \frac{\text{ICO}_2}{\text{g sugar}} \right] = 0.271599039164 - (0.310674946821 \times \text{Yield})$$


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FIG.8

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$$\text{Specific Gravity} = \frac{(3.65201035996 \times 10^{-4}) \times S + 0.999953627005}{}$$

FIG.9

$$Y = \frac{\Delta X}{\Delta S}$$

FIG.10

$$\left[ \frac{\Delta X \text{ (for decay)}}{\Delta time} \right] = b \times X$$

FIG.11

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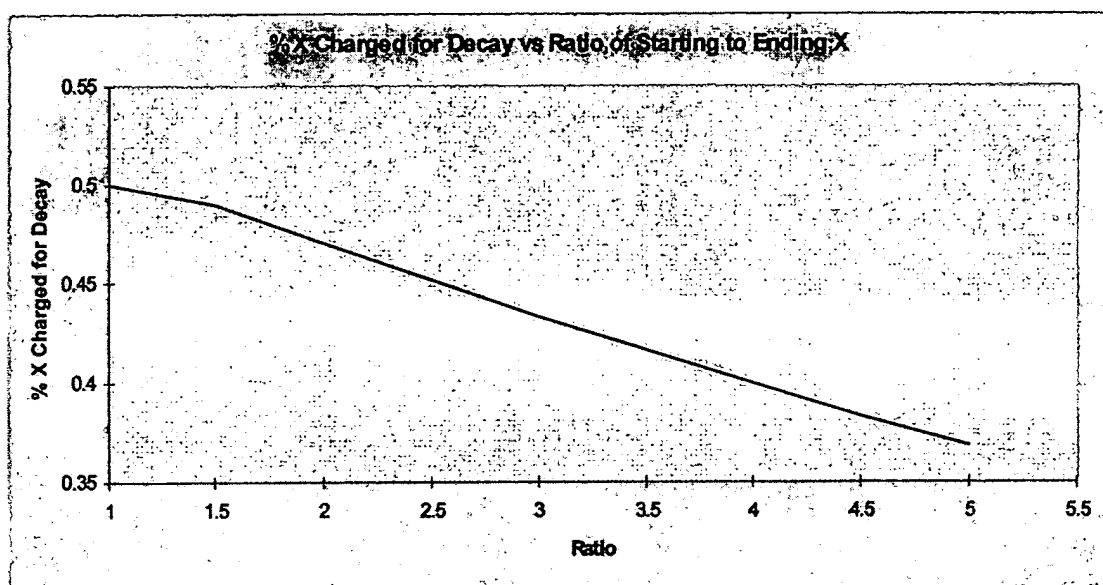
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$$Y = \left[ \frac{\Delta X}{\Delta S} \right] = \left[ \frac{5.14794}{24.644} \right] = 0.20889 \frac{gX}{gS}$$

FIG.12

\*Graph modified\*

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EQXchrgd

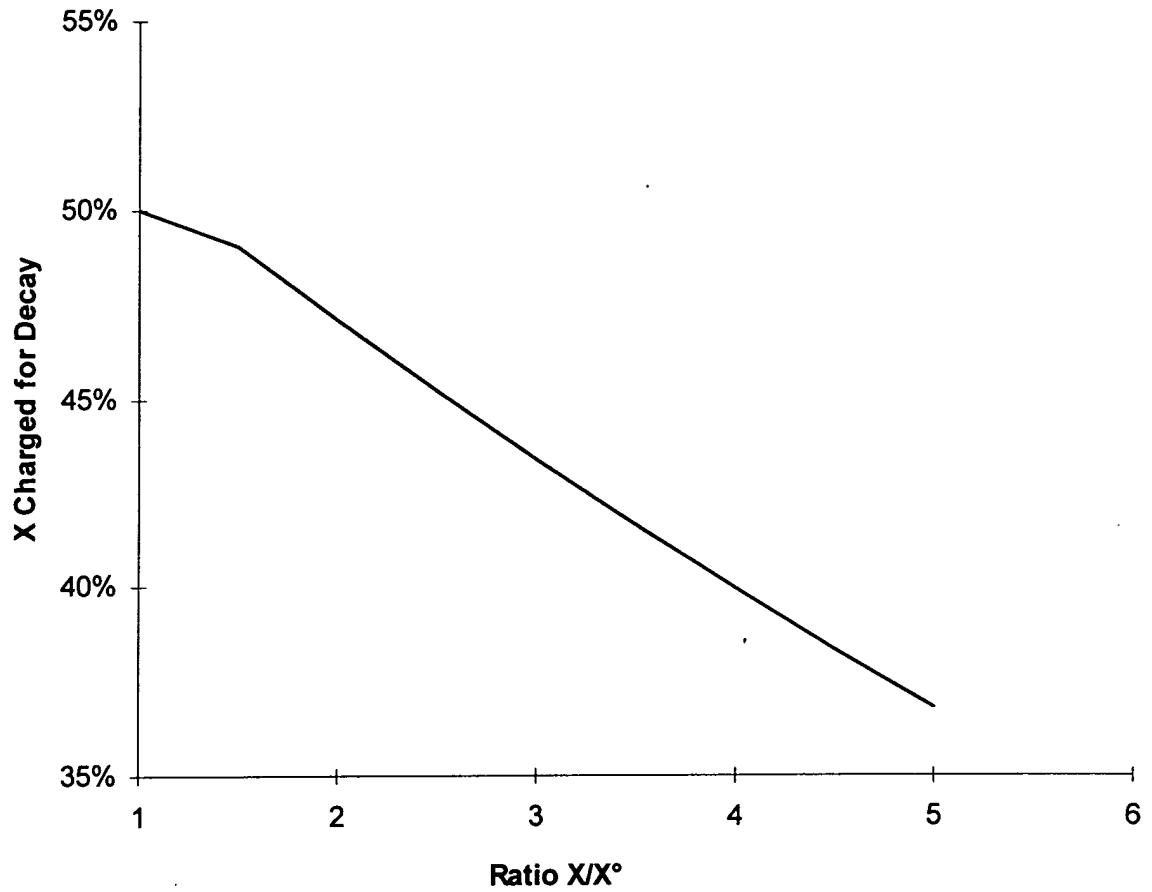
$$Xchrgd = 0.504076447609 \times \text{EXP}(-0.0816252748703 \times \text{Ratio})$$

Figure 3 / Equation 10

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\*Revised graph\*



$$\text{Xchrgd} = 0.504076447609 \times \text{EXP}(-0.0816252748703 \times \text{Ratio})$$

FIG.13

\*Table modified\*

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Sample Name	Time (hours)	X weight (grams)	S.G. Reading (g S/l, see EQSG)	Measured CO2 Flow (ml / min)
$t_0$	0	1.415	183.59	0
$t_1$	15.75	2.73	178.11	3.944
$t_2$	21.03	5.1	158.94	12.344
$t_3$	24.5	6.18	147.99	15.074
$t_4$	44.08	8.38	95.965	7.234

Table 2

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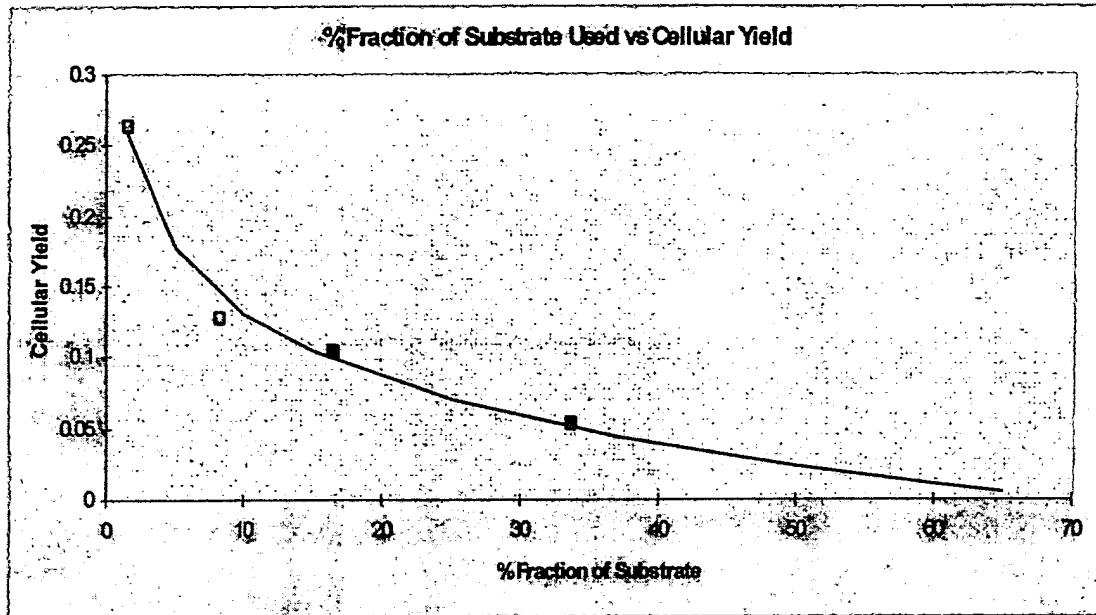
\*Revised table\*

Sample Name	Time (hours)	X weight (grams)	S.G. Reading (g S/l, see EQSG)	Measured CO2 Flow (ml / min)
$t_0$	0	1.415	183.59	0
$t_1$	15.75	2.73	178.11	3.944
$t_2$	21.03	5.1	158.94	12.344
$t_3$	24.5	6.18	147.99	15.074
$t_4$	44.08	8.38	95.965	7.234

FIG.14

\*Graph & table modified, and positions switched\*

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Comparison of the four data points with the yield curve (EQ%used)

$$Y = -6.67814305038 \times 10^{-2} \times [\ln(\%used)] + 0.284841059276$$

log fit;  $r^2 : -.9924$

Figure 4

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\*Table changed to portrait orientation\*

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b=.004/hr

## Test Fermentation Data

A	B	C	D	E	F	G
Interval	Observed New X	Total hours of interval	Mass lost from starting X decay	Sub-total new mass (B + D)	Ratio new X/Start X (Starting X + E) / Starting X	Charge what new mass b?
t <sub>0</sub> - t <sub>1</sub>	1.315	15.75	0.089145	1.404145	1.9923	0.471
t <sub>1</sub> - t <sub>2</sub>	2.37	5.28	0.0576576	2.4276576	1.88925	0.475
t <sub>2</sub> - t <sub>3</sub>	1.08	3.2	0.06528	1.14528	1.22457	0.5
t <sub>3</sub> - t <sub>4</sub>	2.2	19.58	0.4840176	2.6840176	1.434307	0.493

A	H	I	J	K	L	M
Interval	Decay of new mass (E x G x C x .004)	Total new mass yield (E + H)	Amount of sugar used (g/l)	Average % S consumed	Yield (fm curve) g X / g S	% of actual Yield
t <sub>0</sub> - t <sub>1</sub>	0.0416652	1.4458102	5.48	1.4925	0.263833977	97.83%
t <sub>1</sub> - t <sub>2</sub>	0.024354261	2.45201186	19.17	8.206	0.127908809	112.80%
t <sub>2</sub> - t <sub>3</sub>	0.007329792	1.152609792	10.95	16.409	0.105261168	93.10%
t <sub>3</sub> - t <sub>4</sub>	0.103634643	2.7876522	52.025	33.56	0.053582936	93.72%

Table 3

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\*Revised table and graph\*

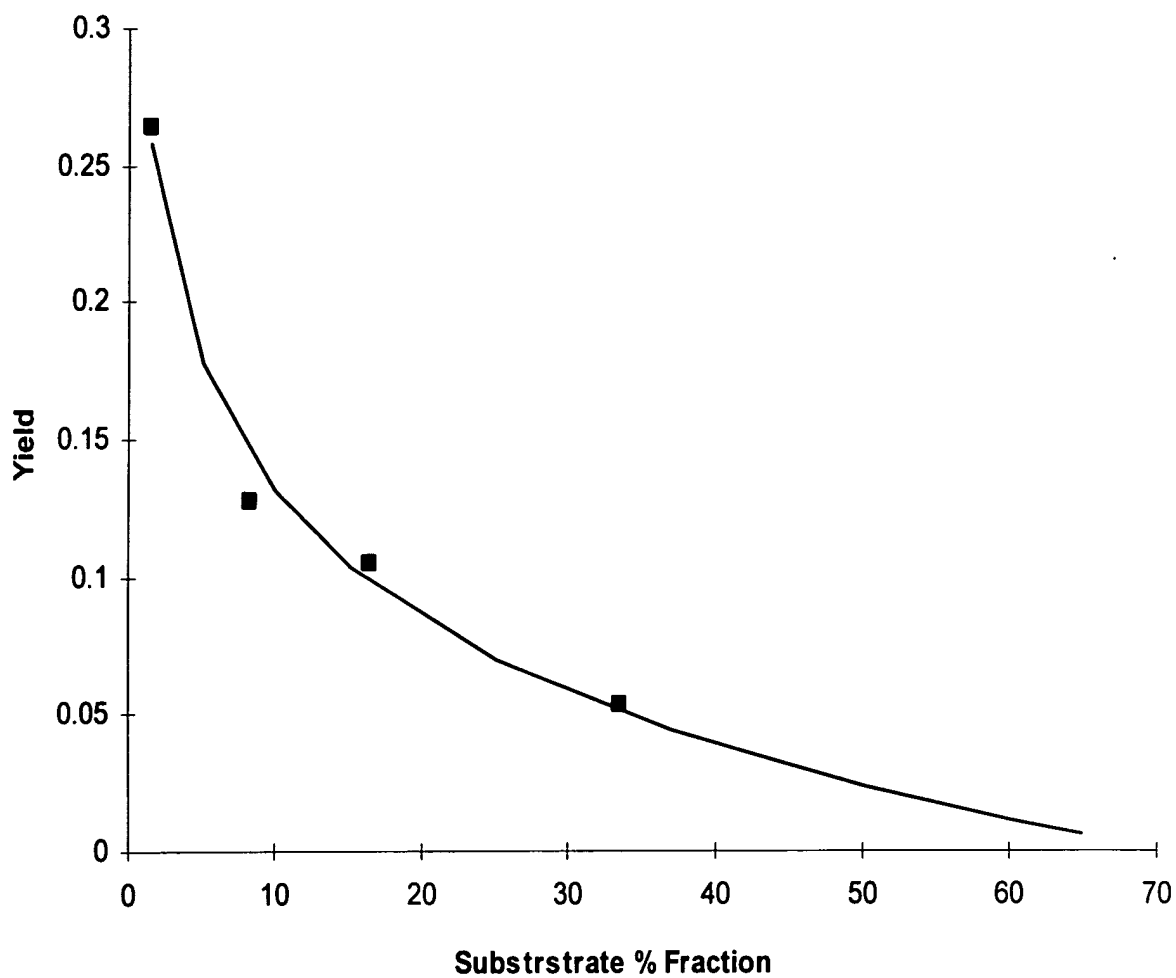
A Interval	B Observed New X	C Total hours of interval	D Mass lost from starting X decay
$t_0 - t_1$	1.315	15.75	0.089145
$t_1 - t_2$	2.37	5.28	0.0576576
$t_2 - t_3$	1.08	3.2	0.06528
$t_3 - t_4$	2.2	19.58	0.4840176
A Interval	E Sub-total new mass (B + D)	F Ratio new X/Start X (Starting X + E) / Starting X	G Charge what new mass b? (EQXchrgd)
$t_0 - t_1$	1.404145	1.9923	0.471
$t_1 - t_2$	2.4276576	1.88925	0.475
$t_2 - t_3$	1.14528	1.22457	0.5
$t_3 - t_4$	2.6840176	1.434307	0.493
A Interval	H Decay of new mass (E x G x C x .004)	I Total new mass yield (E + H)	Amount of sugar used (g/l)
$t_0 - t_1$	0.0416652	1.4458102	5.48
$t_1 - t_2$	0.024354261	2.45201186	19.17
$t_2 - t_3$	0.007329792	1.152609792	10.95
$t_3 - t_4$	0.103634643	2.7876522	52.025
A Interval	J Average % S consumed	K Yield g X / g S	L Yield (fm curve) g X / g S
$t_0 - t_1$	1.4925	0.263833977	0.258098264
$t_1 - t_2$	8.206	0.127908809	0.144275124
$t_2 - t_3$	16.409	0.105261168	0.097997972
$t_3 - t_4$	33.56	0.053582936	0.05021553
A Interval	M % of actual Yield		
$t_0 - t_1$	97.83%		
$t_1 - t_2$	112.80%		
$t_2 - t_3$	93.10%		
$t_3 - t_4$	93.72%		

FIG.15

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$$Y = \left\{ -6.67814305038 \times 10^{-2} \times [\ln(\% \text{used})] \right\} + 0.284841059276$$

FIG.16

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\*Table changed to portrait orientation\*

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Table 4

Evaluation of Test Fermentation					
Interval	% fraction of S	Yield fm EQ%used	Ratio fm EQYld (l CO <sub>2</sub> /g X)	Total new X (grams)	
t <sub>0</sub> - t <sub>1</sub>	1.4925	0.2580973	0.79324921	1.445803	
t <sub>1</sub> - t <sub>2</sub>	8.206	0.14427497	1.52663404	2.452006	
t <sub>2</sub> - t <sub>3</sub>	16.409	0.097998	2.3594534	1.1526299	
t <sub>3</sub> - t <sub>4</sub>	33.56	0.0502161	5.00801093	2.787623	

Interval	liters CO <sub>2</sub> predicted fm model (g X x Ratio)	liters CO <sub>2</sub> predicted by actual Yield	Average measured CO <sub>2</sub> (ml / min)	liters CO <sub>2</sub> predicted fm avg of measured CO <sub>2</sub> flow rate at this interval	
t <sub>0</sub> - t <sub>1</sub>	1.1469	1.1192	1.972	1.8635	
t <sub>1</sub> - t <sub>2</sub>	3.7433	4.2872	8.144	2.58	
t <sub>2</sub> - t <sub>3</sub>	2.71968	2.5095	13.709	2.6321	
t <sub>3</sub> - t <sub>4</sub>	13.9604	12.9849	11.154	13.1037	

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\*Revised table\*

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Interval	% fraction of S	Yield fm EQ%used	Ratio fm EQYld (l CO <sub>2</sub> /g X)
t <sub>0</sub> - t <sub>1</sub>	1.4925	0.2580973	0.79324921
t <sub>1</sub> - t <sub>2</sub>	8.206	0.14427497	1.52663404
t <sub>2</sub> - t <sub>3</sub>	16.409	0.097998	2.3594534
t <sub>3</sub> - t <sub>4</sub>	33.56	0.0502161	5.00801093
Interval	Total new X (grams)	liters CO <sub>2</sub> predicted fm model (g X x Ratio)	liters CO <sub>2</sub> predicted by actual Yield
t <sub>0</sub> - t <sub>1</sub>	1.445803	1.1469	1.1192
t <sub>1</sub> - t <sub>2</sub>	2.452006	3.7433	4.2872
t <sub>2</sub> - t <sub>3</sub>	1.1526299	2.71968	2.5095
t <sub>3</sub> - t <sub>4</sub>	2.787623	13.9604	12.9849
Interval	Average measured CO <sub>2</sub> (ml / min)	liters CO <sub>2</sub> predicted fm avg of measured CO <sub>2</sub> flow rate at this interval	
t <sub>0</sub> - t <sub>1</sub>	1.972	1.8635	
t <sub>1</sub> - t <sub>2</sub>	8.144	2.58	
t <sub>2</sub> - t <sub>3</sub>	13.709	2.6321	
t <sub>3</sub> - t <sub>4</sub>	11.154	13.1037	

FIG.17

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